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GEOMETRY.

Conducted by B. F. FINKEL, Springfield, Mo. All contributions to this department should be sent to him.

SOLUTIONS OF PROBLEMS.

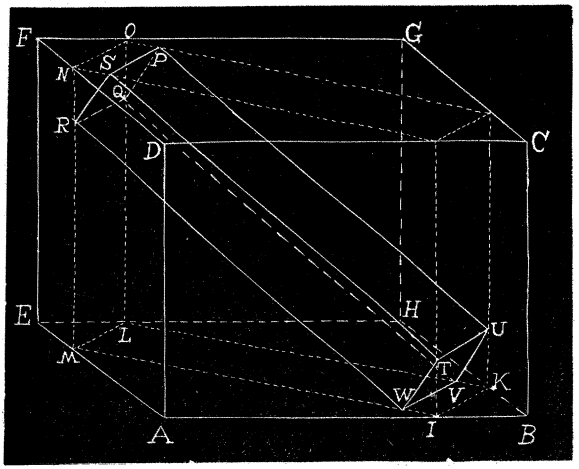
41. Proposed by F. P. MATZ, M. Sc., Ph. D., Professor of Mathematics and Astronomy, Irving College, Mechanicsburg, Pennsylvania.

Find the length (x) of a rectangular parallelopiped $b=5$ feet, and $h=3$ feet, which can be *diagonally inscribed* in a rectangular parallelopiped $L=83$ feet, $B=64$ feet, and $H=50$ feet.

II. Solution by A. H. BELL, Hillsboro, Illinois, and B. F. FINKEL, A. M., Professor of Mathematics and Physics, Drury College, Springfield, Mo.

Let $AB=L=83$ feet, $AE=B=64$ feet, $AD=H=50$ feet, $TUVW-P=$the required inscribed parallelopiped, $VW=b=5$ feet, $WT=h=3$ feet, $BK=z$, $IM=y$, and $WR=TS=UP=VQ=x$.

Then $KH=AM=B-z$, $BI=LE=(b^2-z^2)^{\frac{1}{2}}$, and $AI=HL=L-(b^2-z^2)^{\frac{1}{2}}$.



In the right triangle IAM, $IA^2+AM^2=IM^2$, or

$$[L-(b^2-z^2)^{\frac{1}{2}}]^2+(B-z)^2=y^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1).$$

In the similar triangles IAM and IBK, we have

$$AI : BK=IM : IK, \text{ or } L-(b^2-z^2)^{\frac{1}{2}} : z=y : b ;$$

whence

$$yz=b[L-(b^2-z^2)^{\frac{1}{2}}] \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (2).$$

Solving (2) for y and substituting its value in (1) we have, after reducing and freeing of radicals,

$$4z^4-4Bz^3+[L^2+B^2-4b^2]z^2+2Bb^2z-(L^2-b^2)b^2=0 \quad \ldots\ldots\ldots (3).$$

Restoring numbers, we have

$$4z^4-2562z^3+10885z^2+3200z-171600=0 \quad \ldots\ldots\ldots\ldots (4).$$

Solving this equation by *Horner's Method*, we find $z=4$. $\therefore \sqrt{b^2-z^2}=3$.

$\therefore$ From (1) or (2), $y=100$.

If in (3) we let $L=100$, $B=50$, and $b=3$ and solve the equation again for z, we find $z=2.750413+=TI$. $\therefore IW=1.5248$. $\therefore WR=109.4494693746751+$ feet, the required length of the parallelopiped.

Had we solved equation (2) for z and substituted its value in (1), we would have obtained an equation which would give the length of the rectangle $IMLK$, but it would require a great deal of work to free the equation of radicals. We shall now obtain such an equation, or formula.

Let $AB=L$, $BH=B$, $\theta=\angle AIM$, and $x=IM$. Then $AI=x\cos\theta$, $AM=x\sin\theta$, $IB=b\sin\theta$, $BK=b\cos\theta$.

$$\therefore \text{Area of } ABHE=2[\tfrac{1}{2}AI\times AM+\tfrac{1}{2}BI\times BK]+IM\times IK$$

$$=(x^2+b^2)\cos\theta\sin\theta=ab \quad \ldots\ldots\ldots\ldots (1).$$

Also

$$x\cos\theta+b\sin\theta=L \quad \ldots\ldots\ldots\ldots (2),$$

$$x\sin\theta+b\cos\theta=B \quad \ldots\ldots\ldots\ldots (3).$$

Squaring (2) and (3) and adding the results, we have

$$x^2+c^2+4cx\sin\theta\cos\theta=L^2+B^2 \quad \ldots\ldots\ldots\ldots (4).$$

Equating $\sin\theta\cos\theta$ in (1) and (4), we have, after an easy reduction,

$$x^4-(L^2+B^2+2b^2)x^2+4LBbx-b^2(L^2+B^2-b^2)=0 \quad \ldots\ldots\ldots (5),$$

an equation which gives the length of the longest rectangle of given width which can be diagonally inscribed in a given rectangle.

[NOTE.—It is but justice to Mr. Bell to say that he was obliged to protest long and vigorously before he received a proper hearing to his claim that the published solution of Dr. Matz and Mr. Burleson is wrong. It was simply a case of that injustice commonly done to men when we believe them to be wrong and refuse to examine their claims. This problem was proposed a few years ago in the *School Visitor*, and at that time we solved the problem though we did not try to obtain the numerical result. When Dr. Matz and Mr. Burleson sent in their solution, it seemed to us on cursory examination to be obtained on the same plan pursued by us a few years ago. But after Mr. Bell had written to us on several different occasions, we offered to publish his solution that our readers might compare the results. But before doing so, we examined the published solution in the May No. Vol. II and found that it was wrong. The numerical calculation of $z=WR$ is due to Mr. Bell, as is also the last equation and the method of obtaining it. EDITOR.]

49. Proposed by J. C. WILLIAMS, Rome, New York.

Of all triangles inscribed in a given segment of a circle, with the chord as base, the isosceles is the maximum.

I. Solution by M. A. GRUBER, War Department, Washington, D. C., and A. P. REED, Superintendent of Schools, Clarence, Missouri.

The bases being equal, the maximum triangle is the one having the greatest altitude.